

visible if the pseudopodia were withdrawn. Perhaps some reader of NATURE who has studied these protozoa may be able to tell me whether these striæ are commonly met with (in which case lack of power of observation has caused me previously to overlook them), or whether they may be pathological, resulting from some debility in the organism. Certainly the Amœbæ in which I noticed the striated protoplasm seemed to be as lively as any without it. Like all those whose business it is to teach elementary biology, I have examined hundreds of Amœbæ, but to-day for the first time I saw the condition described. No text-book in my possession refers to or figures it. I shall be happy to send a drawing to anyone who may wish.

Eton College, February 12.

M. D. HILL.

An Alleged Originator of the Theory of Atoms.

MOCHUS OF SIDON, the alleged precursor of Demokritus, is not so unknown to historians of science as Prof. See seems to think (February 13, p. 345), nor is Strabo the only ancient writer who alludes to him; see, for instance, Josephus, "Antiquities," i., 3, 9. But nobody takes him seriously. The book of Mochus is one of the numerous literary forgeries which appeared in Alexandrian times. So far as I can find, it is not mentioned by any of the doxographic writers, so it is probably not much older than the time of Posidonius.

J. L. E. DREYER.

Armagh Observatory.

NOTES ON ANCIENT BRITISH MONUMENTS.¹

V.—Avenues (continued).

SO far I have not referred to the avenues at Shap. Mr. Lewis, in a memoir "on the past and present condition of certain rude stone monuments in Westmorland,"² gives extracts from several authorities showing that in the long past these avenues were not inferior to any in Britain.

Thus Camden (middle of the sixteenth century) writes:—"Several huge stones of a pyramidal form, some of them 9 feet high and 4 feet thick, standing in a row for near a mile, at an equal distance, which seem to have been erected in memory of some transaction there which by length of time is lost." Dr. Stukeley, writing about the middle of the last century, says:—"At the south side of the town of Shap we saw the beginning of a great Celtic avenue on a green common; this avenue is 70 feet broad, composed of very large stones set at equal intervals; it seems to be closed at this end, *which is on an eminence* and near a long flattish barrow with stone works upon it, hence it proceeds northward to the town, which intercepts the continuation of it and was the occasion of its ruin, for many of the stones are put under the foundations of walls and houses, being pushed by machines they call a 'betty,' or blown up with gunpowder; . . . houses and fields lie across the track of this avenue, and some of the houses lie in the enclosure; it ascends a hill, crosses the common road to Penrith, and so goes into the cornfields on the other side of the way westward, where some stones are left standing, one particularly remarkable, called the 'Guggleby' stone³. . . . I guess by the celebrity and number of the stones remaining there must have been 200 on a side" (he says the interval between the stones was 35 feet, which would give about 7000 feet, or nearly a mile and a third, or, allowing for the thickness of the stones themselves, a mile and a half, as the length of the avenue); "near them in several places are remains of circles to be seen of stones set on end, but there are no quantity of barrows about the place, which I wonder at." Gough, in his edition of Camden (1806), says:—"At the south end of the

village, on the common near the road-side [on the east side thereof] is an area upwards of half-a-mile long and between 20 and 30 yards broad, of small stones; and parallel to the road begins a double row of immense granites, 3 or 4 yards diameter, and 8, 10, or 12 yards asunder, crossed at the end by another row, all placed at some distance from each other. This alley extended within memory over a mile quite through the village, since removed to clear the ground; the space between the lines at the south-east end is 80 feet, but near Shap only 59, so that they probably met at last in a point. At the upper end is a circle of the like stones 18 feet diameter." This description is evidently taken by Gough from the "History and Antiquities of the Counties of Westmorland and Cumberland," by Joseph Nicolson, Esq., and Richard Burn, LL.D. (London, 1777), an extract from which has been obligingly communicated to me by Col. Hellard, R.E., the director of the Ordnance Survey, and from which the remark enclosed in square brackets has been taken.

Mr. Lewis informs us that "Camden also mentioned an ebbing and flowing well, which Gough said was lost, and that its peculiarity was purely fortuitous; still it might have been used for the advantage of the priesthood who probably set up the stones. . . . From the descriptions already quoted it would seem that the avenue ran northerly or slightly north-westerly."

With such assiduity were these memorials of the past removed that when the Ordnance survey was made the final examiner recorded in the parish name-book for Shap (1858):—"No one person in the parish of Shap can point out the site of the old avenue of granite stones, or can tell whether the small spot well known as 'Karl Lofts' is the S. or N. end of the Monument. It is most likely the N. end, as about $\frac{1}{2}$ a mile S. is a portion of a circle still to be seen, composed of huge granite boulders, and which probably is the southern turning of the Avenue. It would appear to have been preserved in Doctor Burn's time, but except 2 or 3 boulders, itself and all recollection of it, have faded from Shap."

In spite of this, I think it has been possible to make out the position and direction of the avenues from the few stones shown on the Ordnance 25-inch maps which Col. Hellard has been good enough to send me. Taking the stones of which at least three are in the same straight line, we get two avenues crossing to the E. of the turnpike and to the south of the village, as stated in the preceding descriptions. As measured on the 25-inch Ordnance sheet, the azimuths are S. 19° E. and S. 40° E. From measurements of the contours on the 1-inch map, the elevation of the horizon is about 1° 10' in each case.

These data give us declinations 32° 32' S. and 25° 54' S. respectively.

In bringing together the information available about avenues, I have been greatly struck by the existence of several with an orientation of S. 20°–30° E. The first of this series which I came across, on the ground, were those at Challacombe, an imposing monument once consisting of eight rows of stones with an orientation of N. 23° 27' W., or S. 23° 27' E. ("Stonehenge," p. 158). The rows might have been used in the south-east direction to observe the rising of a southern star; on the other hand, in the north-west direction, they might have been aligned on the setting of Arcturus, warning the summer solstice sunrise in 1860 B.C.

As this date was near to those suggested by the

¹ About 47 chains S. by E. of St. Michael's church.

¹ Continued from p. 251.

² Journal Anthropological Institute, November, 1885.

³ Twenty-six chains S.W. of St. Michael's church. It is about 8 feet high, of a wedge-like or conical shape, placed upright with the heavy end uppermost. (Ordnance surveyor's note.)

other Cornish and Devon monuments, I thought the north-west use was more probable for these avenues and other less imposing ones on Shovel Down with nearly the same direction.

The more recent inquiries, however, suggest that in this I was wrong. In the first place, the evidence now afforded by Mr. Falcon regarding the Assacombe avenue shows that, like those at Merrivale, the look-out to the rising-place was up hill. Again, as at Merrivale, oriented to the rising of the Pleiades, the western end has two large monoliths, ending the two lines of stones, and a single sighting stone at the eastern end is placed *between* the lines.

Now these are the conditions at Challacombe if we assume a south-east use; the view is up hill, and the directing stone is at the eastern end.

I next proceed to give a list of the avenues at present known to me which are roughly parallel with those at Challacombe, and where, possibly, southern stars were in question; curiously enough, this condi-

liths in Britain. The remains at Shap I have not seen, but an avenue nearly a mile long and 70 feet broad, according to Camden and Stukeley, is certainly out of the common.

What, then, might have been the use of these avenues? If they were erected to indicate the rising place of a southern star, the only important one they could have dealt with was α Centauri, and that between B.C. 3000 and B.C. 4000. I give approximate dates where the measures are sufficient to enable me to do so.

Challacombe ...	D.c.	$31^{\circ} 7'$	S.	...	3600 B.C.
Avebury ...		$31^{\circ} 34'$		...	3500
Borobridge ...		$32^{\circ} 15'$		...	3400
Shap ...		$32^{\circ} 32'$		...	3400
Shovel Down ...		$34^{\circ} 46'$		...	2900
Crug yr Avan ...		$36^{\circ} 00'$		...	2700

Now if we take 3500 B.C., that is some thousand years before the time I have suggested to be indicated by the stellar alignments connected with the Cornish

circles. This raises several interesting questions. Why have we circles in Cornwall and practically no avenues? Why have we avenues practically without circles in Brittany?

Was there a swarm of avenue builders who preceded the swarm that built circles?

In this connection it is worthy of notice that in my "Dawn of Astronomy" I made out that there is a series of Egyptian temples oriented to α

Centauri, one of them being the Memnonia at Thebes; and long avenues, generally of sphinxes, were associated with all these temples, while circles were unknown.

Another point is connected with the rise of the star and its use as a warner.

The rise of α Centauri would be preceded shortly by that of β , almost in the same azimuth.

At the time in question, 3500 B.C., they would serve as warners for the November sunrise, which was long afterwards accepted as the beginning of the year by the Celts.

Further, at the dates in question there were no first-magnitude stars rising near the north point of the horizon, as Arcturus and Capella did afterwards, by which the lapse of time during the night might be measured.

The two stars in the Centaur might have been used in this way, but their usefulness would be much restricted owing to the short time they would remain above the horizon.

It is well to note that while the nearly southerly avenue is accompanied at Avebury by a May-year alignment, the second avenue at Shap seems to have been a solstitial one, the sunrise at the Winter solstice being in question. This, however, cannot be considered certain until local observations of the height of the horizon have been made.

Mr. Goddard (NATURE, February 6) has raised objections to my statements concerning the Avebury



FIG. 16.—The Avenue and Circle at Callernish.

Photo. by Prof. Thorpe.

tion applies to the Kennet avenue at Avebury, and to those at Borobridge and Shap.

Challacombe, Dartmoor, lat. $50^{\circ} 36' N$.

S. $23^{\circ} 37' E$, horizon $4^{\circ} 48'$, dec. $31^{\circ} 7' S$.

Avebury, Wiltshire, lat. $51^{\circ} 30' N$.

S. $32^{\circ} E$, horizon $49'$, dec. $31^{\circ} 34' N$.

Borobridge, Yorkshire, lat. $54^{\circ} 6' N$.

S. $25^{\circ} E$, horizon 1° , dec. $32^{\circ} 15' S$.

Shovel Down, Dartmoor, lat. $50^{\circ} 39' N$.

S. $25^{\circ} E$, horizon $0^{\circ} 46'$, dec. $34^{\circ} 46' S$.

(Other alignments at S. $22^{\circ} E$ and S. $28^{\circ} E$.)

Shap, Westmorland, lat. $54^{\circ} 33' N$.

Direction of avenue S. $19^{\circ} E$, horizon $1^{\circ} 10'$, dec. $32^{\circ} 32' S$.

Crug yr Avan Avenue, S. Wales, lat. $51^{\circ} 40' N$.

S. $23^{\circ} E$ and S. $24^{\circ} E$, sea horizon.

With regard to this last avenue, the Rev. J. Griffith informs me that the "stone of honour" ("directing stone"), now recumbent, is at the southern end, and that the land rises in that direction; it would have been on the sky-line as seen from the north end of the avenue.

It is as well to point out at once that some of the monuments included in the above list are the most remarkable in Britain. Challacombe is the only multiple avenue that I have seen in these islands which approaches those in Brittany. The south-east avenue at Avebury was, I take it, the most important feature at one time of that elaborate temple; while, again, the stupendous stones which I think are the remains of an avenue at Borobridge are among the largest mono-

avenues on the ground that in some of the old descriptions, given while many more stones were standing, some are indicated placed in relation to the road passing through the southern part of the bank, as it exists at present, and quite out of the line of the Kennet avenue indicated by the stones shown on the Ordnance map. If the stones once near the road were associated with those shown on the Ordnance map, there would be no avenue at all in the sense I have always used that word in these notes, but a twisty road having no possible astronomical significance, and, I may add, no resemblance to the Beckhampton avenue, of which all the recorded stones are in the same straight line as near as we can now say; or to any of the others in the table I have given above.

It may be, indeed, that Stukeley was led into his snake theory by attempting to marry these two sets of stones, for he sees a snake even at Calternish, the perfectly straight avenue of which fortunately remains.

"I saw another at Shap, in Westmorland. . . . There is another, as I take it, at Classeness, a village in the island of Lewis between Scotland and Ireland. I took a drawing of it from Mr. Lwydd's travels; but he was a very bad designer . . . a part of the snake remains going from it, which he calls an avenue. He did not discern the curve of it any more than that of Kennet, avenue which he also has drawn in the same collection as a straight line."¹

If the conclusions I have expressed above be confirmed, namely, that Avebury was a going concern a thousand years before anything that now remains of Stonehenge was set up in its present position, or the avenues laid out, the use of the Kennet avenue to watch the rise of α Centauri as a warner of the November festival (while the sunrise in May was provided for in the Beckhampton avenue) ceased at least 4000 years ago. There has been ample time, therefore, to build the bank, to leave openings for wheeled traffic and to set up stones in many places. Indeed, the stones may have been removed from the avenue when the bank was built. That the bank came long after Avebury was first in use was, I take it, well known to Stukeley, as the following extract shows:—

¹ Stukeley, "Avebury," p. 62.

"When Lord Stowell, who owned the manor of Abury, levell'd the vallum on that side of the town next the church, where the barn now stands, the workmen came to the original surface of the ground, which was easily discernible by a black stratum of mold upon the chalk. Here they found large quantities of bucks' horns . . . there were very many burnt bones among them. They were the remains of sacrifices."¹

Mr. Goddard does not seem to have read my previous notes carefully. I never imagined the Kennet avenue going "over the bank and ditch," but going to the southern circle *before the mound was built*, as the Beckhampton went to the other, as a *via sacra*, throughout the whole length of which the rising star could be seen. Of course, the existence of the bank

Alignements orthogonaux de Leuré
(Canton de Crozon)
 $L = 48^{\circ}16'N. - G = 6^{\circ}50.5W$
Echelle : 2 m/m pour 1 m

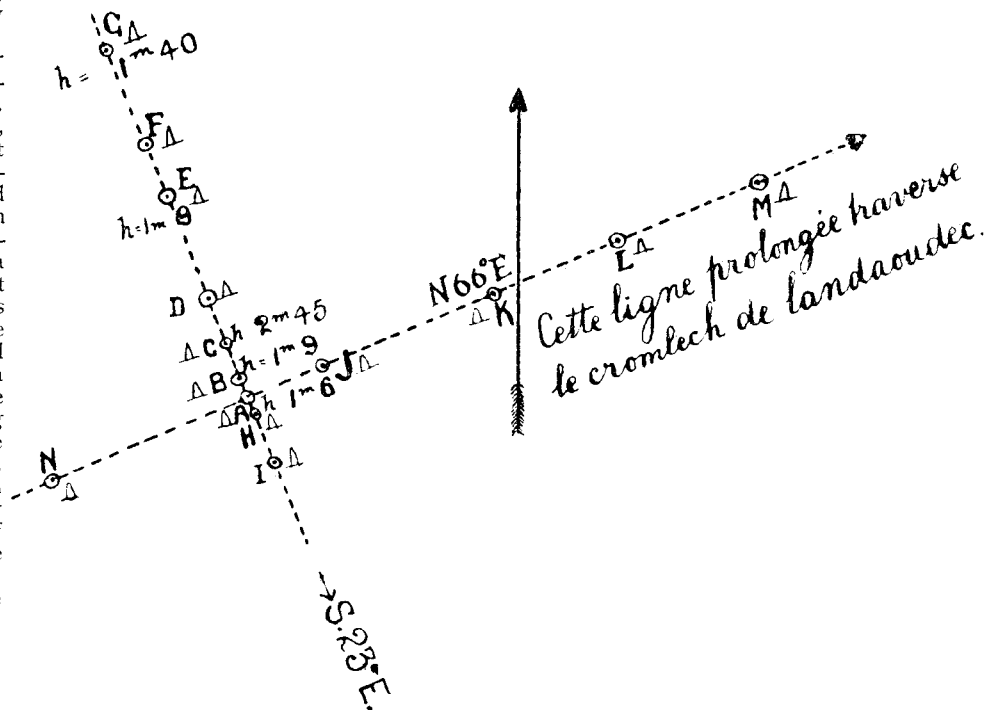


FIG. 17.—The alignments at Leuré from Captain Devoir's observations.

would have prevented any star rise being seen from the circle along the southern horizon, and what often happened in Egypt suggests that the bank was built because the avenue had become useless.

That the Kennet avenue was once used as a *via sacra* to observe the rise of α Centauri as the morning star warner of the November sunrise is all the more probable since the avenue from the southern end of the Kennet avenue to the "sanctuary" was an alignment to the November sunrise itself so far as can now be made out.

Since writing the above I have received from Captain Devoir, of the French Navy, some admirable surveys of several of the Brittany monuments. In one

¹ Stukeley, "Avebury," p. 27.

at Leuré we have two avenues, one S. 23° E. and another N. 66° E. (Fig. 17), avenues therefore practically parallel to the two at Avebury, and doubtless used for the same purposes.

NORMAN LOCKYER.

A STUDY OF THE RIVER TRENT.¹

THIS little book is a clearly written popular account, in part amplified, and in part—rather unfortunately, we think—abbreviated, of the author's presidential address to the Lincolnshire Naturalists' Union. It deals with the geological structure and history of the Lindsey division of Lincolnshire, especially in relation to the vicissitudes, actual or supposed, of the river Trent.

The author is not the first, nor is he likely to be the last, to try conclusions with the intricate story of the Lincoln Gap, that sharp and sudden breach through the escarpment of the Lower Oolites by

are devoted to an exposition of Prof. Davis's work, and his very convenient terminology is explained with all necessary clearness, though the general reader for whom the book is written will no doubt be puzzled by the reference without the necessary definition to a "peneplain."

The author attributes over-much of the levelling of the great plains of the Jurassic clays to the Trent, and seems to imply that while these valleys were in process of formation the escarpments by which they are bounded stood where we now see them, a confusion which he shares with many recent writers, who fail to recognise that escarpments are incessantly receding. On the other hand, it is satisfactory to find that he takes due account of the possibility that the Trent may have been captured by the Humber drainage in pre-Glacial times, have been restored to its primeval course through the Lincoln Gap in consequence of an ice-barrier across the Humber, and again in post-Glacial times re-captured by the Humber



Photo.

The Ægir, Gainsborough, October 12, 1904. Showing the after-waves, locally called "The Whelps." From "The Shaping of the Lindsey and Trent."

E. W. Carter, Gainsborough.

which the little strike-river, the Witham, abruptly doubles across into the fenlands of the Oxford, Ampthill, and Kimeridge clays, and so reaches the Wash.

Since the publication in 1862 of Jukes's epoch-marking paper on the river valleys of the south of Ireland, in which the cardinal principle of river-capture was enunciated, the Trent and its anomalous course has furnished a theme and an illustration to writers on our British rivers. Ramsey used it, Mr. Jukes Browne added much additional evidence and gave greater definiteness to our conceptions of the potentialities of river-adjustment, and Prof. Davis, in his splendid contribution to evolutionary potamology, adopted and amplified Mr. Jukes Browne's views. Still later Mr. Burton further extended the study of the Trent, and furnished data inaccessible except to a Trent-side resident. The earlier chapters of his book

system, though not so decisively but that in seasons of flood it swept again across from the old elbow of capture at Newark and discharged its waters into the Wash. The Romans controlled this propensity by the erection of extensive floodbanks, but the degenerate moderns neglected to keep them in repair, so that in 1795, and twice in more recent times, the river has temporarily re-occupied its old course.

The later history and activities of the Trent are well described, and a special word of commendation must be bestowed upon the splendid half-tone illustrations, and in particular the two pictures of the bore or Ægir ("Sea-tempest is the Jötun Ægir, a very dangerous Jötun; and now to this day, on our river Trent as I learn, the Nottingham bargemen, when the river is in a certain flooded state . . . call it *Eager*; they cry out 'Have a care, there is Eager coming.'"—Carlyle). These are, we think, the finest pictures of this phenomenon that we remember to have seen. The excellence of the half-tone illustra-

¹ "The Shaping of Lindsey by the Trent." By F. M. Burton. Pp. xii+59. (London: A. Brown and Sons, Ltd., 1907.) Price 2s. net.